

CLAIMS

1. A threshold value matrix used for converting a multi-level image data into a plural-level image data which represents a dot pattern by a smaller number of gradation levels than the multi-level image data, comprising:

threshold values used for making a dot representation solely by a dot pattern while maintaining an identical keytone for all halftone levels.

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2. The threshold value matrix as claimed in claim 1, further comprising:

a plurality of sub matrixes; and

a basic matrix for combining the sub matrixes,

15 said sub matrixes and said basic matrix having similar line-group keytones.

3. The threshold value matrix as claimed in claim 2, wherein at least said sub matrixes have a size of 3 x 3 and
20 an inclined line-group keytone.

4. The threshold value matrix as claimed in any of claims 1 to 3, which is used to always simultaneously generate three or more dots per gradation level.

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5. The threshold value matrix as claimed in any of claims 1 to 4, wherein a threshold value immediately before switching a dot size has a value identical to a first threshold value for a dot size of a next stage.

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6. The threshold value matrix as claimed in any of claims 1 to 5, which excludes a matrix which independently generates a dense dot pattern for which a keytone is not visually recognizable by human eye.

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7. The threshold value matrix as claimed in any of claims 1 to 6, wherein only odd numbered threshold values are used to form an incomplete set of dots at a gradation level where a keytone is easily lost due to increased dot density.

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8. The threshold value matrix as claimed in any of claims 1 to 7, wherein one side of the threshold value matrix is always a multiple of eight.

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9. An image processing apparatus comprising:

a processing section carrying out a plural-level process with respect to a multi-level image data to output a plural-level image data which represents a dot pattern by a smaller number of gradation levels than the multi-level image data by use of a threshold value matrix; and

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a holding section holding said threshold value matrix which includes threshold values which are used for making a dot representation solely by a dot pattern while maintaining an identical keytone for all halftone levels.

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10. The image processing apparatus as claimed in claim 9, wherein said processing section uses the threshold value matrix by rotating the threshold value matrix based on the multi-level image data or specified output setting information.

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11. The image processing apparatus as claimed in claim 10, wherein said processing section rotates the threshold value matrix so that directions of keytones are identical between a portrait mode which uses an output picture vertically so that a longer side of the picture is vertical and a landscape mode which uses the output picture horizontally so that the longer side of the picture is horizontal.

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12. The image processing apparatus as claimed in any of claims 9 to 11, wherein said threshold value matrix comprises a plurality of sub matrixes, and a basic matrix for combining the sub matrixes, said sub matrixes and said basic matrix having similar line-group keytones.

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13. The image processing apparatus as claimed in claim 12, wherein at least said sub matrixes have a size of 3 x 3 and an inclined line-group keytone.

5 14. The image processing apparatus as claimed in any of claims 9 to 13, wherein said holding section holds a threshold value matrix which is used to always simultaneously generate three or more dots per gradation level.

10 15. The image processing apparatus as claimed in any of claims 9 to 14, wherein a threshold value immediately before switching a dot size has a value identical to a first threshold value for a dot size of a next stage, within the threshold value matrix.

15 16. The image processing apparatus as claimed in any of claims 9 to 15, wherein said holding section holds the threshold value matrix excluding a matrix which independently generates a dense dot pattern for which a keytone is not
20 visually recognizable by human eye.

 17. The image processing apparatus as claimed in any of claims 9 to 16, wherein said holding section holds the threshold value matrix in which only odd numbered threshold
25 values are used to form an incomplete set of dots at a

gradation level where a keytone is easily lost due to increased dot density.

18. The image processing apparatus as claimed in
5 any of claims 9 to 17, wherein one side of the threshold value matrix is always a multiple of eight.

19. A printer driver, to be implemented in a computer, for supplying an output image data to an image
10 forming apparatus which forms an image from a plurality of dots, comprising:

a processing section carrying out a plural-level process with respect to a multi-level image data to output, as the output image data, a plural-level image data which represents
15 a dot pattern by a smaller number of gradation levels than the multi-level image data by use of a threshold value matrix; and

a table storing said threshold value matrix which includes threshold values which are used for making a dot representation solely by a dot pattern while maintaining an
20 identical keytone for all halftone levels.

20. The printer engine as claimed in claim 19, wherein said processing section uses the threshold value matrix by rotating the threshold value matrix based on the
25 multi-level image data or specified output setting information.

21. The printer engine as claimed in claim 20,
wherein said processing section rotates the threshold value
matrix so that directions of keytones are identical between a
portrait mode of the image forming apparatus which uses an
5 output picture vertically so that a longer side of the picture
is vertical and a landscape mode of the image forming
apparatus which uses the output picture horizontally so that
the longer side of the picture is horizontal.

10 22. The printer engine as claimed in any of claims
19 to 21, wherein said threshold value matrix comprises a
plurality of sub matrixes, and a basic matrix for combining
the sub matrixes, said sub matrixes and said basic matrix
having similar line-group keytones.

15 23. The printer engine as claimed in claim 22,
wherein at least said sub matrixes have a size of 3 x 3 and an
inclined line-group keytone.

20 24. The printer engine as claimed in any of claims
19 to 23, wherein said table stores a threshold value matrix
which is used to always simultaneously generate three or more
dots per gradation level.

25 25. The printer engine as claimed in any of claims

19 to 24, wherein a threshold value immediately before switching a dot size has a value identical to a first threshold value for a dot size of a next stage, within the threshold value matrix.

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26. The printer engine as claimed in any of claims 19 to 25, wherein said table stores the threshold value matrix excluding a matrix which independently generates a dense dot pattern for which a keytone is not visually recognizable by
10 human eye.

27. The printer engine as claimed in any of claims 19 to 26, wherein said table stores the threshold value matrix in which only odd numbered threshold values are used to form
15 an incomplete set of dots at a gradation level where a keytone is easily lost due to increased dot density.

28. The printer engine as claimed in any of claims 19 to 27, wherein one side of the threshold value matrix is
20 always a multiple of eight.

29. An image forming apparatus which forms an image on a recording medium from a plurality of dots, comprising:

25 a processing section carrying out a plural-level process

with respect to a multi-level image data to output a plural-level image data which represents a dot pattern by a smaller number of gradation levels than the multi-level image data by use of a threshold value matrix;

5 a table storing said threshold value matrix which includes threshold values which are used for making a dot representation solely by a dot pattern while maintaining an identical keytone for all halftone levels; and

 an imaging section forming the image on the recording
10 medium based on the plural-level image data.

30. The image forming apparatus as claimed in claim 29, wherein said processing section uses the threshold value matrix by rotating the threshold value matrix based on
15 the multi-level image data or specified output setting information.

31. The image forming apparatus as claimed in claim 30, wherein said processing section rotates the
20 threshold value matrix so that directions of keytones are identical between a portrait mode which uses the recording medium vertically so that a longer side of the recording medium is vertical and a landscape mode which uses the
recording medium horizontally so that the longer side of the
25 recording medium is horizontal.

32. The image forming apparatus as claimed in any
of claims 29 to 31, wherein said threshold value matrix
comprises a plurality of sub matrixes, and a basic matrix for
combining the sub matrixes, said sub matrixes and said basic
5 matrix having similar line-group keytones.

33. The image forming apparatus as claimed in
claim 32, wherein at least said sub matrixes have a size of 3
x 3 and an inclined line-group keytone.
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34. The image forming apparatus as claimed in any
of claims 29 to 33, wherein said table stores a threshold
value matrix which is used to always simultaneously generate
three or more dots per gradation level.
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35. The image forming apparatus as claimed in any
of claims 29 to 34, wherein a threshold value immediately
before switching a dot size has a value identical to a first
threshold value for a dot size of a next stage, within the
20 threshold value matrix.

36. The image forming apparatus as claimed in any
of claims 29 to 35, wherein said table stores the threshold
value matrix excluding a matrix which independently generates
25 a dense dot pattern for which a keytone is not visually

recognizable by human eye.

37. The image forming apparatus as claimed in any
of claims 29 to 36, wherein said table stores the threshold
5 value matrix in which only odd numbered threshold values are
used to form an incomplete set of dots at a gradation level
where a keytone is easily lost due to increased dot density.

38. The image forming apparatus as claimed in any
10 of claims 29 to 37, wherein one side of the threshold value
matrix is always a multiple of eight.

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